Surveys (FIC in PNW)
SPR 12-1

Forest Insect Conditions

in the PACIFIC NORTHWEST during 1957

by J. M. WHITESIDE

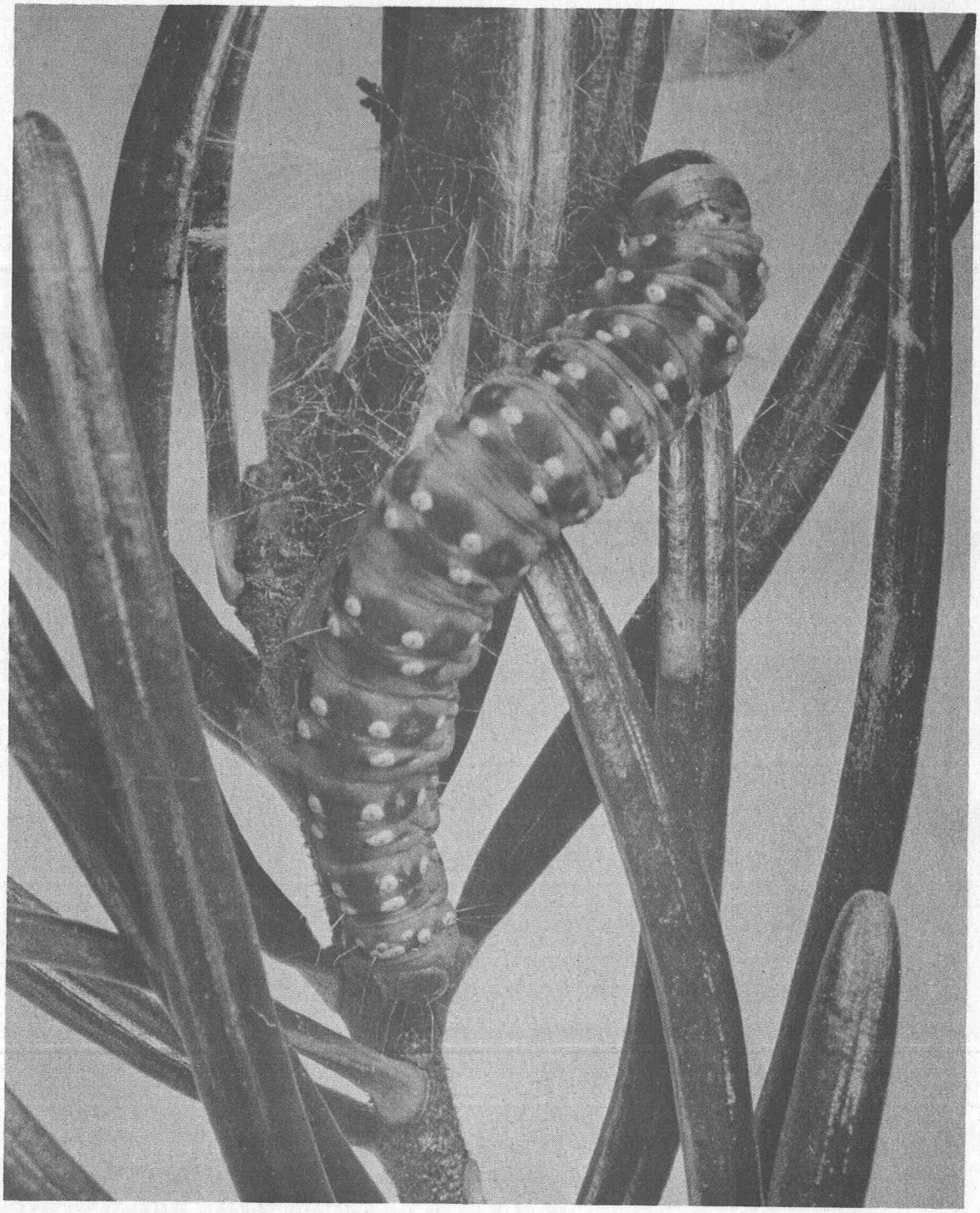
Spruce budworm *Choristoneura fumiferana* (Clem.)

Balsam woolly aphid *Chermes piceae* (Ratz.)

Western pine beetle *Dendroctonus brevicomis* Lec.

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
U. S. DEPT. OF AGRICULTURE • FOREST SERVICE
NOVEMBER 1958

T. M. FILE COPY REFERENCE LIBRARY



Sixth instar spruce budworm larva spinning its web on foliage prior to pupation. Aerial spraying operations are directed against the 4th, 5th, and 6th instars and, to be fully effective, must be completed before the pupal stage is reached.

FOREST INSECT CONDITIONS

IN THE PACIFIC NORTHWEST

DURING 1957

by

J. M. Whiteside

Division of Forest Insect Research

November 1958

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
R. W. Cowlin, Director Portland, Oregon

FOREST SERVICE U. S. DEPARTMENT OF AGRICULTURE

PREFACE

Annual determination of the status and trend of forest insect populations in the Pacific Northwest[1/] is a primary responsibility of the Division of Forest Insect Research of the Pacific Northwest Forest and Range Experiment Station. Cooperation is provided by Federal and State land-managing agencies, forest industries, and interested private landowners. The Station summarizes and reports the findings.

Results of the 1957 survey are presented in this report. Because of their importance in forest management and general similarity to insect-caused damage and mortality, the damage caused by bears and losses of western hemlock from unknown causes are discussed under the heading "Other Pest Problems in 1957." Brief mention of porcupine damage is also made in this section.

Insect conditions were evaluated from four primary sources of information: (1) regional aerial detection and appraisal surveys, (2) ground surveys, (3) ground observations by foresters and entomologists, and (4) insect material submitted to the Station by private and public landowners and land managers.

Grateful acknowledgment is made to all who participated in the survey program. Special credit is given for the assistance and information provided by the principal cooperators: Oregon State Board of Forestry, Washington Department of Natural Resources, and the Weyerhaeuser Timber Company.

[1/] Oregon and Washington; except Lincoln, Pend Oreille, Spokane, Whitman, and parts of Ferry and Stevens Counties in Washington. These northeastern Washington counties are covered by the Missoula (Montana) Forest Insect Laboratory, a unit of the Intermountain Forest and Range Experiment Station, Ogden, Utah.

CONTENTS

	Page
Frontispiece	
Preface	
SURVEY FINDINGS IN BRIEF	1
IMPORTANT FOREST INSECT OUTBREAKS IN 1957	4
Defoliators	4
Spruce Budworm	4
Black-Headed Budworm	10
Spruce Bud Moth	13
Larch Bud Moth	14
Sucking Insects	15
Balsam Woolly Aphid	15
Bark Beetles	17
Western Pine Beetle	17
Douglas-Fir Beetle	18
Mountain Pine Beetle	21
Engelmann Spruce Beetle	23
Oregon Pine Ips	24
Fir Engraver	25
Silver Fir Beetles	25
Miscellaneous Forest Insects	26
Defoliators	26
Bark Beetles and Bark Weevils	27
Aphids	27
Scales	28
OTHER FOREST PEST PROBLEMS IN 1957	28
Bear Damage	28
Dying Hemlock	31
Porcupine Damage	32

Page

APPENDIX 32
Organization and Conduct of Surveys 32
Aerial Surveys 32
Ground Surveys 34
Table 15. Extent of epidemic infestations in Oregon in 1957, by forest area, insect species, and intensity of infestation 35
Table 16. Extent of epidemic infestations in Washington in 1957, by forest area, insect species, and intensity of infestation 43
Figure 2. Spruce budworm situation in Oregon and Washington, season of 1957 . . . . . .
Figure 3. Generalized areas of forest insect epidemics in Oregon and Washington, other than spruce budworm, season of 1957 . . . . . .

SURVEY FINDINGS IN BRIEF

Outbreaks of forest insects in the Pacific Northwest increased in extent and severity after 3 successive years of decline. Epidemic infestations totalled 2,130,560 acres, with 1,477,920 acres (69.4 percent) in Oregon and 652,640 acres (30.6 percent) in Washington.

The trend of insect-caused outbreaks in the two States since 1953 has been as follows (million acres):

	Oregon	Washington	Total
1953	6.3	1.9	8.2
1954	5.7	1.9	7.6
1955	1.4	.8	2.2
1956	.9	.5	1.4
1957	1.5	.6	2.1

Significant findings of the 1957 survey, presented in detail in the following pages, are as follows:

1. Thirteen species of insects (8 bark beetles, 4 defoliators, and 1 sucking insect) were responsible for the recorded damage (table 1). The acreage and intensity of infestation for each insect are presented in table 15 for Oregon and in table 16 for Washington. In addition, the areas of infestation of spruce budworm are shown in figure 2 and those of six other important forest insects, in figure 3. Tables 15 and 16 and figures 2 and 3 are located in the appendix.

2. Outbreaks of the following species reappeared after a lapse of one to several years:

   a. Black-headed budworm.--Defoliations in stands of western hemlock, Douglas-fir, and true fir in Washington were spectacular and caused much concern.

Table 1.--Summary of 1957 forest insect epidemic infestations in Oregon and Washington[1/]

Insects	Oregon		Washington		Regional Total	
	Infestation centers	Area	Infestation centers	Area	Infestation centers	Area
	Number	Acres	Number	Acres	Number	Acres
Defoliating insects:						
Spruce budworm	80	830,960	0	0	80	830,960
Black-headed budworm	0	0	51	252,800	51	252,800
Spruce bud moth	47	46,560	7	5,600	54	52,160
Larch bud moth	0	0	29	39,520	29	39,520
All defoliators	127	877,520	87	297,920	214	1,175,440
Sucking insects:						
Balsam woolly aphid	277	385,200	228	214,560	505	599,760
Bark beetles:						
Western pine beetle	76	39,040	7	2,720	83	41,760
Douglas-fir beetle	49	10,880	28	7,520	77	18,400
Mountain pine beetle	182	104,000	256	108,000	438	212,000
Engelmann spruce beetle	35	24,480	12	7,680	47	32,160
Oregon pine ips	120	26,880	13	1,760	133	28,640
Fir engraver	31	9,920	19	11,360	50	21,280
Silver fir beetles (2)	0	0	5	1,120	5	1,120
All bark beetles	493	215,200	340	140,160	833	355,360
All insects	897	1,477,920	655	652,640	1,552	2,130,560

[1/] All of Washington except Lincoln, Pend Oreille, Spokane, Whitman and parts of Ferry and Stevens Counties.

b. Silver fir beetles. --Light damage to Pacific silver fir by two species of beetles reappeared on two areas in northwestern Washington.

c. Spruce bud moth. --Damage in coastal spruce stands was severe, especially on the Siuslaw National Forest.

3. Increasing infestation trends were recorded for five species, as follows:

a. Balsam woolly aphid. --Infested acreage increased slightly in the Washington Cascades but increased greatly in the Oregon Cascades.

b. Engelmann spruce beetle. --Damage increased, especially on the Wallowa-Whitman National Forests.

c. Larch bud moth. --Defoliation was severe on the Okanogan National Forest.

d. Spruce budworm. --Infestations increased in acreage and severity, especially in the central Blue Mountains of Oregon. Aerial spraying operations were to be resumed in 1958.

e. Western pine beetle. --Losses increased noticeably in Oregon forests.

4. Decreasing infestation trends were recorded for four species, as follows:

a. Douglas-fir beetle. --Damage was insignificant in comparison with that caused annually since 1950.

b. Fir engraver. --Losses in upper-slope types continued the downward trend evident since 1950.

c. Mountain pine beetle. --Losses in lodgepole, ponderosa, and western white pine stands decreased in Washington forests, but increased slightly in Oregon.

d. Oregon pine ips. --Attacks were noticeably lighter, especially in the Blue Mountains of Oregon.

IMPORTANT FOREST INSECT OUTBREAKS IN 1957

Defoliators

SPRUCE BUDWORM
Choristoneura fumiferana (Clem.)

Epidemic infestations of the spruce budworm were recorded in the Pacific Northwest for the 14th consecutive year (fig. 1).

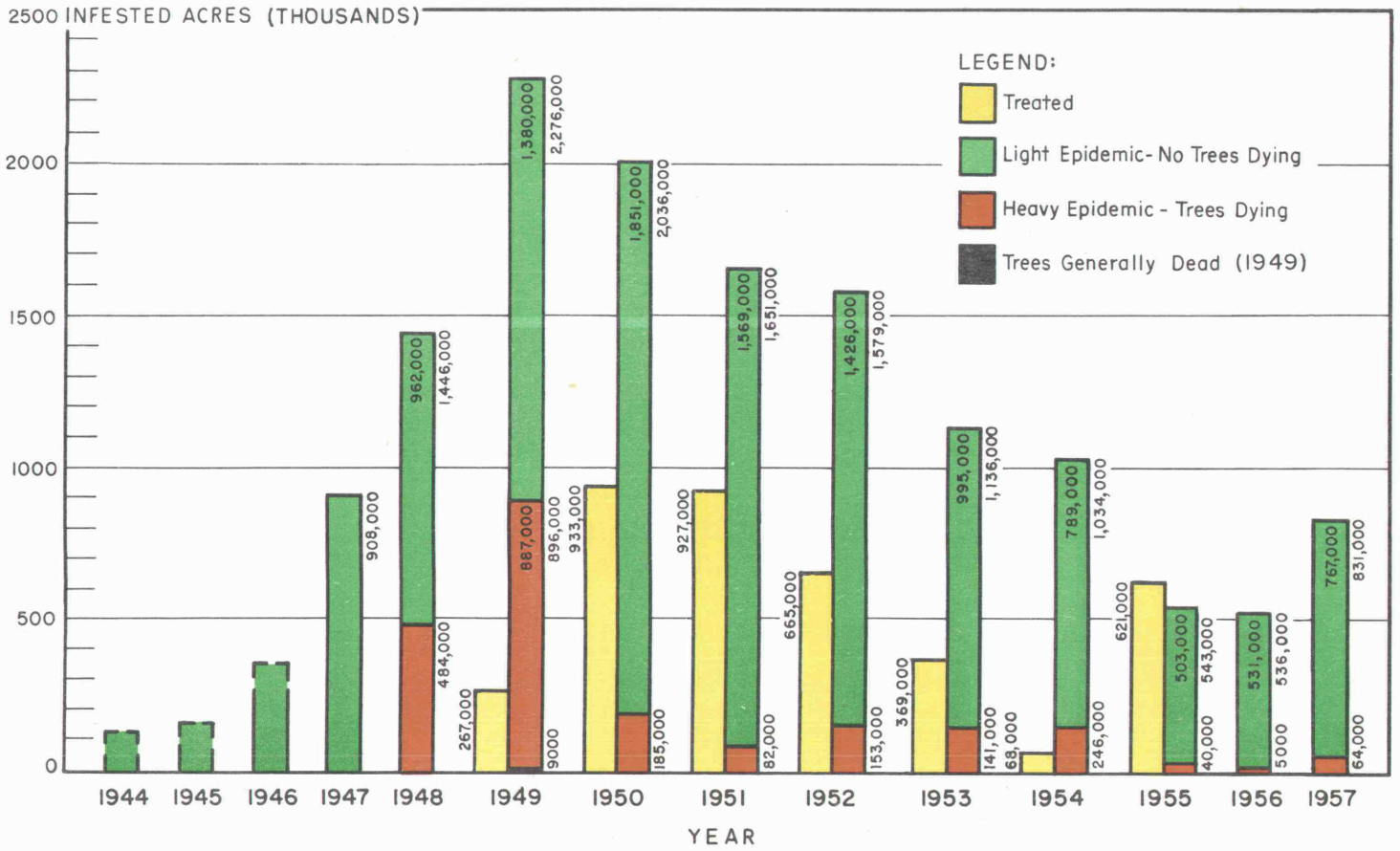
The destruction of valuable Douglas-fir, true fir, and Engelmann spruce resources has been averted by a successful, cooperative aerial spraying program. During the 7-year period 1949-55, 3,840,000 acres of epidemic infestations and buffer zones were treated at a cost of about $1.05 per acre. Control recommendations for this program have been made annually by the Northwest Forest Pest Action Council and have been based on the results of cooperative regional surveys and the findings of research personnel.

Situation in 1957.--Because the Action Council in 1956 recommended suspension of control operations, there was no aerial spraying for budworm control in the Pacific Northwest in 1957. It was felt that the improved parasite situation, a downward infestation trend, and a reduced threat of tree killing justified this action.

Instead of continuing to decline in 1957, however, budworm infestations increased by 294,840 acres and the intensity worsened as shown by the following comparison:

Intensity	1957		1956	
	(Acres)	(Percent)	(Acres)	(Percent)
Light epidemic	512,940	61.7	467,180	87.1
Moderate epidemic	254,480	30.6	63,660	11.9
Heavy epidemic	61,780	7.5	5,280	1.0
Very heavy epidemic	1,760	.2	--	--
Total	830,960	100.0	536,120	100.0

FIGURE 1 - PROGRESS OF SPRUCE BUDWORM EPIDEMIC IN OREGON AND WASHINGTON, 1944-57



USDA-SCS PORTLAND, OREG. 1957

All current infestations were in the Blue Mountains of Oregon, as follows:

	Acres	Percent
Central Blue Mountains	710,800	85.6
Wallowa Mountains	101,600	12.2
Southwestern Blue Mountains	18,560	2.2
Total	830,960	100.0

As shown in table 2, the Malheur, Wallowa-Whitman, and Umatilla National Forests contained the bulk of the 1957 budworm infestations.

Table 2.--Extent of 1957 spruce budworm infestations, by administrative area and intensity of infestation[1/]

(In acres)

Administrative area[2/]	Intensity of infestation				All intensities
	Light	Moderate	Heavy	Very heavy	
Malheur N.F.	203,840	132,640	31,600	0	368,080
Wallowa-Whitman N.F.	215,340	80,160	6,400	640	302,540
Umatilla N.F.	83,840	41,600	23,200	1,120	149,760
Ochoco N.F.	9,920	0	0	0	9,920
Lookout Mt. (Baker Co.)	0	80	580	0	660
All areas	512,940	254,480	61,780	1,760	830,960

1/ Areas include infestations on private, State, and Federal lands.

2/ N.F.: national forest.

The current infestations were separated into 21 logical control units (table 3). As shown, most of the infestations were in the light and moderate classes and the ownership was mostly Federal.

During the period September 18-20, the 6-man Spruce Budworm Committee of the Northwest Forest Pest Action Council made

Table 3.--Extent of spruce budworm infestations in Oregon in 1957, by control unit, intensity of infestation, and ownership class

Control unit	Intensity of infestation					Ownership class[1/]		
	Light	Moderate	Heavy	Very heavy	Total	Federal	Other	Total
	Acres					Percent		
1. Rocky Butte	1,120	0	0	0	1,120	100.0	0	100
2. Brush Creek	4,800	0	0	0	4,800	100.0	0	100
3. Maury Mountain	320	0	0	0	320	100.0	0	100
4. Snow Mountain	3,680	0	0	0	3,680	64.1	35.9	100
5. Aldrich Mountain	38,720	12,160	2,240	0	53,120	83.2	16.8	100
6. Strawberry Mountain	102,880	24,000	1,600	0	128,480	89.7	10.3	100
7. Dixie Butte	39,520	73,280	24,880	0	137,680	88.6	11.4	100
8. Silver Butte	128,640	114,080	26,560	1,120	270,400	97.6	2.4	100
9. Sumpter	34,560	2,400	160	0	37,120	97.6	2.4	100
10. Bald Ridge	24,960	8,000	5,760	0	38,720	75.5	24.5	100
11. Unity	22,560	1,920	0	0	24,480	97.5	2.5	100
12. Wolf Mountain	480	0	0	0	480	100.0	0	100
13. King Mountain	7,360	0	0	0	7,360	90.5	9.5	100
14. Antelope Mountain	800	0	0	0	800	100.0	0	100
15. Moss Spring	22,380	4,320	0	0	26,700	99.6	.4	100
16. Pine Creek	22,080	4,000	0	0	26,080	99.2	.8	100
17. Joseph	13,120	3,840	0	0	16,960	95.2	4.8	100
18. Snake	17,280	5,760	0	640	23,680	99.6	.4	100
19. Chesnimnus	6,880	640	0	0	7,520	91.5	8.5	100
20. Lookout Mountain	0	80	580	0	660	81.8	18.2	100
21. Cable Creek	20,800	0	0	0	20,800	74.8	25.2	100
All units	512,940	254,480	61,780	1,760	830,960	--	--	--
Average (wtd.)	--	--	--	--	--	92.2	7.8	100

[1/] Approximate division of broad ownership classes.

its annual examination of currently infested areas. The committee made an aerial reconnaissance of the principal problem units, ground-checked representative infested stands, discussed timber values and control needs with local groups, reviewed local reports of budworm damage, and considered the status of the budworm population as revealed by special sampling by research biologists. At the ninth annual meeting of the Council in Portland, Oreg., in October, survey findings were reviewed and discussed and the committee report was presented. The membership unanimously voted to resume control operations in 1958 and recommended treatment of about 812,000 acres. The proposed project included the main centers of epidemic infestation in the central Blue Mountains area and necessary buffer zones.

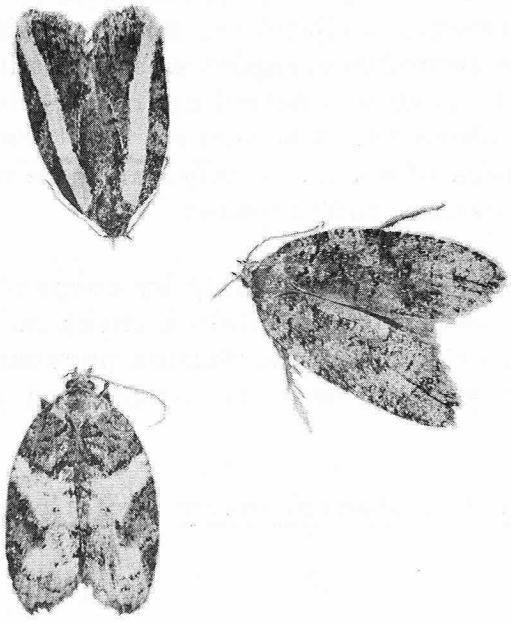
Reexamination of spruce budworm ground plots by cooperators was not requested in 1957. However, to maintain a check on light budworm populations in certain critical areas, Station personnel recruised representative plots in the western parts of Oregon and Washington, as follows:

	Budworm present	Budworm absent	Total plots
Western Oregon	26	26	52
Western Washington	16	7	23
All plots	42	33	75

Even though the budworm was recorded on 56 percent of the plots in these regions, populations were well below the epidemic level.

The annual reexamination of trend plots on sprayed areas in Oregon again revealed mostly light budworm populations; however, it was noted that slightly higher numbers of budworm were recorded in 1957 than on the same plots in 1956. The 1957 measurements showed from 3 to 27 budworms per 100 15-inch twigs during the bud-feeding period; whereas in 1956 the count ranged from 0 to 20. In practically all cases the number of associated bud feeders, principally species of little economic importance, exceeded the number of spruce budworm on each plot.

BLACK-HEADED BUDWORM
Acleris variana (Fern.)



Pattern variations of the adult, x3.

Epidemic infestations of the black-headed budworm, covering 252,800 acres, were recorded on six forest areas in the Washington Cascades in 1957 (table 4). The largest areas of damage were found in the Snoqualmie National Forest and were contiguous to those in Mount Rainier National Park. The most aggressive centers of infestation were found in the White River drainage, with heaviest defoliation occurring in Huckleberry Creek. Western hemlock, true firs, and Douglas-fir were the principal species attacked, with heaviest feeding on western hemlock.

This defoliator appears to have a propensity for Washington forests, since outbreaks in the Pacific Northwest have been recorded only in that

Egg on underside of needle x8.

Caterpillar, x3.

Pupa, x3.

State. Although some feeding occurs each year in both Oregon and Washington, this sudden appearance of large populations over a wide area has caused considerable concern.

Table 4.--Extent of black-headed budworm infestations in 1957, by administrative area and intensity of infestation[1/]

Administrative area[2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Snoqualmie N.F.	29	115,840	35,680	9,440	1,280	162,240
Yakima I.R.	5	24,480	0	0	0	24,480
Mt. Baker N.F.	6	22,240	1,120	0	0	23,360
G. Pinchot N.F.	6	17,760	800	0	0	18,560
Mt. Rainier N.P.	4	16,320	0	0	0	16,320
Glenwood District (W.D.N.R.)	1	6,560	1,280	0	0	7,840
All areas	51	203,200	38,880	9,440	1,280	252,800

1/ Areas include damage on lands of all ownerships.

2/ N.F.: national forest; I.R.: Indian reservation; N.P.: national park; W.D.N.R.: Washington Department of Natural Resources.

Two facts concerning the current epidemic are of special interest: (1) this is the first recorded outbreak since a 1944 epidemic on the Olympic Peninsula, and (2) this is the first large outbreak in the Washington Cascades.

Traces of the black-headed budworm were found in the eastern Oregon Cascades and in the Blue Mountains. In both areas, Douglas-fir appeared to be the preferred host species. These centers of infestation were not of sufficient intensity to detect from the air. They appear to be part of a general increase in black-headed budworm populations in the Pacific Northwest.

Egg-sampling surveys in the White River, Wash., drainage in the fall of 1957 revealed relatively few eggs (table 5). It was felt that the infestation was declining and that defoliation in 1958 would be considerably lighter.

No control measures were recommended; however, the situation was scheduled for careful checking in 1958 to determine the status of the epidemic and the need for control.

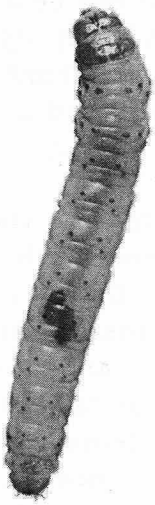
Table 5.--Black-headed budworm egg populations at 10 points in the Snoqualmie National Forest--Mount Rainier National Park area of infestation

Collection point	Intensity of infestation	Eggs laid on 18-inch twigs (1957)	Eggs laid on 500 linear inches of foliage		
			1957	1956	Ratio 1957:1956
	Class	Number	--- Number ---		
End of Burma Road	Very light	0.0	0	3	---
Jim Creek	Light	0.7	2	3	0.67
Grass Mountain	Light	2.1	5	38	0.13
Frying Pan River	Light	2.4	10	31	0.32
Twin Camp Road #1	Light	2.8	14	31	0.45
West Fork Road	Light—Moderate	3.6	18	17	1.06
Buck Creek	Moderate	6.2	26	40	0.65
Twin Camp Road #2	Moderate	8.8	31	50	0.62
Huckleberry Ridge	Moderate—Heavy	11.9	38	74	0.51
North Boundary of Park	Heavy	15.7	47	25	1.88

SPRUCE BUD MOTH
Zeiraphera ratzeburgiana Sax.

Outbreaks of the spruce bud moth in coastal Sitka spruce stands were recorded on 52,160 acres. Defoliated stands were detected from Gold Beach, Oreg., to Tatoosh Island, Wash.

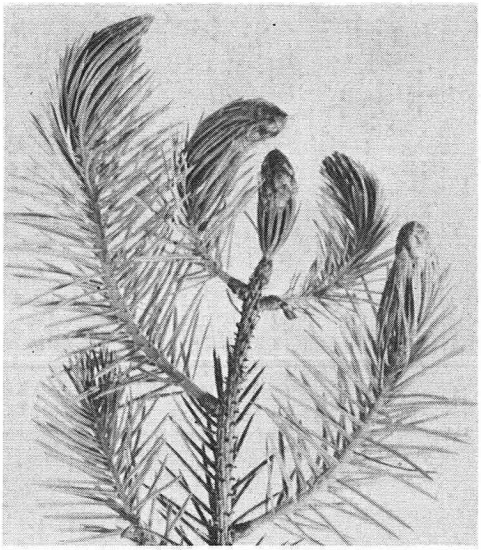
Heaviest damage was observed in the Siuslaw National Forest and the northwestern counties of Oregon (33,760 acres and 12,800 acres, respectively.) Most of the centers of infestation were placed in the light-intensity class.



Larva of spruce bud moth, x5.

This is the first recorded outbreak of the spruce bud moth since modern surveys were started in the Pacific Northwest in 1947. In many stands, both mature and immature trees were defoliated.

At present, no direct control measures against this defoliator are warranted.



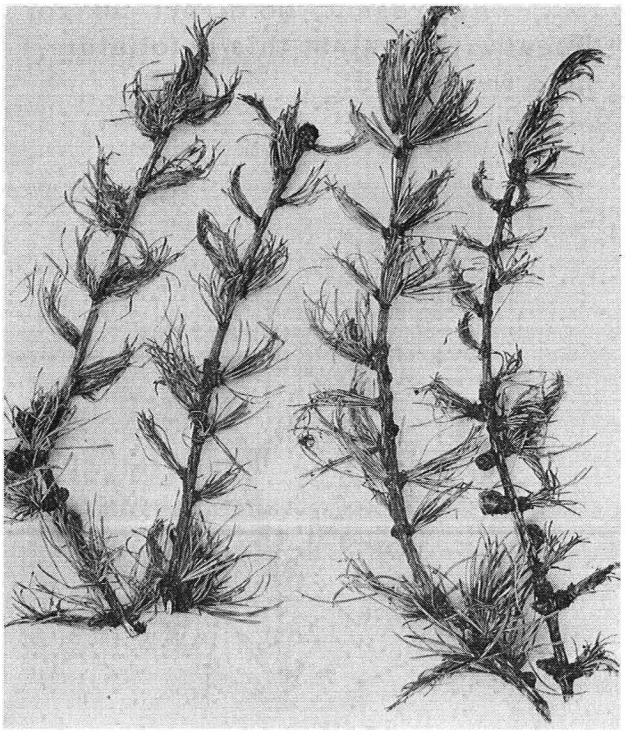
New buds of Sitka spruce webbed together by larvae of spruce bud moth.

LARCH BUD MOTH
Zeiraphera griseana (Hübner)

Defoliation of western larch by the larch bud moth increased markedly in extent and severity in 1957 over that recorded in 1956. Current epidemic infestations covered 39,520 acres, whereas only 1,080 acres of damage was reported in 1956. Heaviest infestations (37,120 acres) were on the Okanogan National Forest.

Larva of the larch bud moth, x3.

During the period of larval activity, western larch takes on a sickly appearance. Many needles are entirely consumed, whereas others are partly eaten and later dry and turn red. However, the trees soon put out new shoots, which obscure the effects of defoliation. Tree mortality appears to be insignificant although annual growth rates may be reduced as a result of repeated defoliations.



Work of the larch bud moth.

Despite its name, larch bud moth is often common on Douglas-fir. In one larval instar, it closely resembles and is often mistaken for larvae of the spruce budworm. In the Blue Mountains, Oreg., area, larvae of the larch budworm could be readily collected in 1957; however, its feeding was neither concentrated nor serious enough to be detected on aerial surveys.

No direct control measures are needed against this defoliator at present.

Sucking Insects

BALSAM WOOLLY APHID
Chermes piceae (Ratz.)

This imported European insect is currently the most talked-of forest pest in the Pacific Northwest. Infestations in 1957 affected 599,760 acres, of which 385,200 acres were in Oregon and 214,560 acres were in Washington (table 6). The 1956 infestations covered 355,990 acres. Although epidemic infestations increased by only 10,780 acres in Washington, they increased by 232,990 acres in Oregon. The bulk of the infestation is in the Cascade Range of the two States. Severe mortality has occurred in merchantable stands of Pacific silver fir in both States. The damage is also severe in subalpine fir forests that are noncommercial but that have high watershed and recreational values.

In Oregon the largest area of damage (220,000 acres) occurred in subalpine fir stands on the Willamette National Forest. However, the most intense tree killing occurred in the Black Rock area on and adjacent to the Siuslaw National Forest. In this area, much of the overstory Pacific silver fir is dead and understory trees are severely affected.

In Washington, most of the damage continues to occur on and adjacent to the Gifford Pinchot National Forest, particularly in the Mount St. Helens area. The accumulated effects of aphid feeding since 1954 have resulted in heavy killing and in marked deterioration of the crowns of heavily attacked but still living trees.

Salvage programs have been organized by private, State, and Federal owners, but depressed lumber and pulp markets and rapid deterioration of the affected trees have resulted in a heavy loss of wood. In spite of these conditions, salvage operations in the older centers of infestation were continued.

The Chermes Committee of the Pest Action Council continued its active work in emphasizing the aphid problem and in encouraging additional marketing of Pacific silver fir.

Research on the aphid problem was given high priority in 1957 by the Station and cooperators.

Table 6.--Extent of balsam woolly aphid infestations in 1957, by administrative area and intensity of infestation[1/]

Administrative area[2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Oregon:						
Willamette N.F.	132	123,520	62,080	29,120	5,280	220,000
Mt. Hood N.F.	77	54,400	19,520	2,400	320	76,640
Deschutes N.F.	34	12,320	17,600	21,280	1,920	53,120
Siuslaw N.F.	15	13,120	8,000	480	4,160	25,760
Warm Springs I.R.	15	6,080	1,920	0	0	8,000
N.W. Oregon (O.S.B.F.)	3	1,600	0	0	0	1,600
Umpqua N.F.	1	80	0	0	0	80
Oregon areas	277	211,120	109,120	53,280	11,680	385,200
Washington:						
G. Pinchot N.F.	210	92,960	51,200	51,520	6,720	202,400
S.W. Washington (W.D.N.R.)	4	7,040	0	160	0	7,200
Mt. Rainier N.P.	4	960	0	0	0	960
Snoqualmie N.F.	10	3,680	320	0	0	4,000
Washington areas	228	104,640	51,520	51,680	6,720	214,560
All areas	505	315,760	160,640	104,960	18,400	599,760

[1/] Areas include damage on lands of all ownerships.

[2/] N.F.: national forest; I.R.: Indian reservation; N.P.: national park; O.S.B.F.: Oregon State Board of Forestry; W.D.N.R.: Washington Department of Natural Resources.

Bark Beetles

WESTERN PINE BEETLE
Dendroctonus brevicomis Lec.

A general increase in ponderosa pine mortality from western pine beetle attacks occurred region-wide in 1957. Single dead trees were more numerous and small groups of two or three appeared in some localities. However, the infestation remained in the low endemic category and only in a few locations was it sufficiently concentrated to warrant mapping.

Western pine beetle damage was recorded on 41,760 acres as compared with 16,030 acres in 1956. Heaviest losses (12,480 acres) were recorded on the Ochoco National Forest, mostly on Lost Creek south of Lookout Mountain and in the vicinity of Maury Mountain and Snow Mountain.

A few small centers were recorded on the east side of the Mount Hood National Forest, on the Warm Springs Indian Reservation, and on the Deschutes National Forest as far south as the McKenzie Highway. Moderately severe losses occurred in the vicinity of Cache Mountain on the Deschutes National Forest.

Similar groups were scattered across the southern part of the Klamath Indian Reservation and onto the Fremont National Forest south of the Lakeview—Klamath Falls Highway.

In Washington, heaviest losses (1,600 acres) were recorded on the Okanogan National Forest. Three small infestations were mapped on the Yakima Indian Reservation, but none appeared to be aggressive.

Salvage of currently infested, windthrown,and dead trees is recommended. Removal of high-risk trees through sanitation-salvage logging, before the trees are attacked by the western pine beetle, is a proved and effective way of reducing pine beetle losses. The practice should be encouraged to the fullest extent practicable.

DOUGLAS-FIR BEETLE
Dendroctonus pseudotsugae Hopk.

Epidemic infestations of the Douglas-fir beetle dropped from 5,071,750 acres in 1954 to 18,400 acres in 1957 (table 7). This rapid decline was evident both east and west of the Cascade Range.

In Oregon, moderate outbreaks persisted on two forests (table 8). On the Rogue River National Forest, 4,800 acres of damage were recorded. A general flareup of beetle activity occurred late in the season when the beetles invaded trees suffering from severe mistletoe infection, particularly on the Applegate District, where the mistletoe problem is acute. On the Willamette National Forest, 2,240 acres of infestations were recorded.

In the Snake River area of the Wallowa-Whitman National Forests, the Douglas-fir beetle is continuing to kill trees in unsprayed areas severely defoliated by the spruce budworm. Although tree killing has declined, some rather large groups of trees were killed in 1957.

In Washington, the highest concentrations of beetles continue to occur on the Colville Indian Reservation. Although this situation has improved, small centers of light-to-moderate infestations are continuing to show up in the southeastern part of the reservation.

Salvage operations in the older centers of infestation, developing in the 1951-52 blowdown and subsequent beetle-kill areas, are nearly concluded. Continued efforts to salvage dead and dying, windthrown, and fire-scorched trees in areas of recent damage are recommended in order to utilize the trees before deterioration renders them unsuited for lumber.

Foresters and entomologists are always concerned about the possibility of major outbreaks of the Douglas-fir beetle in the Pacific Northwest similar to the one that followed the stand disturbances of the winter of 1951-52. Although indications are that no severe blowdown occurred during the winter of 1956-57, prompt salvage of windthrown timber, both scattered and concentrated, should be encouraged. By quickly removing this breeding material from the forests, killing of large areas of green timber may be prevented.

Table 7.--Trend of Douglas-fir beetle infestations, 1951-57

(In acres)

Year of detection	Area of epidemic infestation		
	Oregon	Washington[1/]	Total
1951	132,800	35,200	168,000
1952	4,111,730	458,400	4,570,130
1953	4,153,900	678,900	4,832,800
1954	4,440,540	631,210	5,071,750
1955	640,160	232,960	873,120
1956	20,770	96,130	116,900
1957	10,880	7,520	18,400

[1/] Except Lincoln, Pend Oreille, Spokane, Whitman, and parts of Ferry and Stevens Counties.

Table 8.--Extent of Douglas-fir beetle infestations in 1957, by administrative area and intensity of infestation[1/]

Administrative area[2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Oregon:						
Rogue River N.F.	17	1,600	960	1,920	320	4,800
Willamette N.F.	11	1,600	640	0	0	2,240
Siuslaw N.F.	6	960	0	0	0	960
Mt. Hood N.F.	3	0	800	0	0	800
Ochoco N.F.	3	320	320	0	0	640
N.W. Oregon (O.S.B.F.)	2	160	160	0	0	320
Umpqua N.F.	2	320	0	0	0	320
Umatilla N.F.	1	240	0	0	0	240
Siskiyou N.F.	1	160	0	0	0	160
Wallowa-Whitman N.F.	1	160	0	0	0	160
Coos Bay (O.S.B.F)	1	160	0	0	0	160
Umatilla I.R.	1	80	0	0	0	80
Oregon areas	49	5,760	2,880	1,920	320	10,880
Washington:						
Colville I.R.	25	4,160	2,880	0	0	7,040
Wenatchee N.F.	3	480	0	0	0	480
Washington areas	28	4,640	2,880	0	0	7,520
All areas	77	10,400	5,760	1,920	320	18,400

[1/] Areas include damage on lands of all ownerships.

[2/] N.F.: national forest; I.R.: Indian reservation; O.S.B.F.: Oregon State Board of Forestry.

MOUNTAIN PINE BEETLE
Dendroctonus monticolae Hopk.

Mountain pine beetle damage in 1957 occurred on 212,000 acres as compared with 252,760 acres in 1956. Current infestations were about equally divided between Oregon and Washington. However, those in Oregon increased over the level reported in 1956, whereas those in Washington decreased.

Mortality of four species of pine was recorded: lodgepole, ponderosa, sugar, and western white (table 9). Heaviest damage again occurred in western white pine stands.

Salvage of dead and dying trees of each species is recommended on all areas.

Table 9.--Extent of mountain pine beetle infestations in 1957, by host species

(In acres)

Host species	Oregon	Washington	Regional total
Western white pine	29,280	102,560	131,840
Lodgepole pine	73,920	5,440	79,360
Ponderosa pine	640	0	640
Sugar pine	160	0	160
All species	104,000	108,000	212,000

Infestations in western white pine stands.--In most of its range in the two States, western white pine is infected with blister rust. The mountain pine beetle kills both infected and noninfected trees. This lethal combination is gradually reducing the volume of mature western white pine in the region.

In 1957, the largest area of damage (55,840 acres) was found in the Gifford Pinchot National Forest, where the infestations were scattered throughout the pine stands of the forest. Current damage was not as severe as in previous years, being mostly in the light and moderate infestation classes.

Infestations in lodgepole pine stands. --Killing of lodgepole pine by the mountain pine beetle was slightly less in 1957 than in 1956. Infestations in the older centers of damage continued.

The largest concentration of damage (30,880 acres) was found on the Deschutes National Forest, mostly in the Wanoga Butte area. This infestation is still going strong, with the centers of tree killing shifting within the boundary of the infestation as the host material becomes exhausted. Other old centers of infestation around Chemult have increased in size and a number of new, aggressive infestations have appeared.

On the Rogue River National Forest, an old infestation near Buck Lake is still active and tree mortality is continuing. An infestation in Wheeler Creek basin, reported in 1956 and involving both the forest and Crater Lake National Park, has largely subsided from natural causes plus direct measures. Although no control was attempted on national-forest land in the basin, the Park Service effectively treated 389 trees with ethylene dibromide in fuel oil (6 fl. oz. to 5 gal.) in the spring of 1957.

Small aggressive centers of infestation were scattered over much of the lodgepole pine stands on the Klamath Indian Reservation and the Fremont National Forest. On the latter forest, losses were heavy west of Cougar Rock and on Dead Horse Creek.

Infestations in ponderosa pine stands. --Mountain pine beetle infestations in ponderosa pine stands were less severe in 1957 than in 1956. Most of the damage (480 acres) was found on the Wallowa-Whitman National Forests.

Infestations in sugar pine stands. --Measurable losses in sugar pine stands from mountain pine beetle attacks were confined to Lone Branch Creek on the Rogue River National Forest. After the aerial survey had been completed, numerous widely scattered, single trees and small groups of two or three trees were reported in the South Fork of the Umpqua River drainage on the Umpqua National Forest. These trees faded late in the season.

ENGELMANN SPRUCE BEETLE
Dendroctonus engelmanni Hopk.

Although Engelmann spruce forms only a small part of the total forest resource of the Pacific Northwest, it is a valuable species. Stands of spruce are often subject to aggressive attacks by the Engelmann spruce beetle, usually developing from windthrown trees. In 1957, epidemic infestations were recorded on 32,160 acres. This compares with 14,880 acres in 1956.

Heaviest losses were recorded on the Wallowa-Whitman National Forests (table 10), with the bulk of the damage occurring in

Table 10.--Extent of Engelmann spruce beetle infestations in 1957, by administrative area and intensity of infestation[1/]

Administrative area[2/]	Infestation centers	Intensity of infestation			All intensities
		Light	Moderate	Heavy	
	Number	----------	Acres	----------	
Oregon:					
Wallowa-Whitman N.F.	28	6,400	4,000	9,120	19,520
Willamette N.F.	5	4,000	480	0	4,480
Malheur N.F.	1	0	320	0	320
Umatilla N.F.	1	160	0	0	160
Oregon areas	35	10,560	4,800	9,120	24,480
Washington:					
Yakima I.R.	2	0	3,840	0	3,840
Snoqualmie N.F.	6	1,600	480	0	2,080
Umatilla N.F.	2	960	0	0	960
Wenatchee N.F.	1	0	480	0	480
Okanogan N.F.	1	0	320	0	320
Washington areas	12	2,560	5,120	0	7,680
All areas	47	13,120	9,920	9,120	32,160

1/ Areas include damage on lands of all ownerships.

2/ N.F.: national forest; I.R.: Indian reservation.

the Anthony Lake area. Numerous centers of infestation have been present in these high-elevation stands for several years and heavy losses have taken place. Some of the centers are in excellent stands of spruce. Salvage operations have been started in this area, but need to be expanded.

Light-to-moderate infestations were recorded on the Willamette, Umatilla, and Snoqualmie National Forests and the Yakima Indian Reservation. Salvage operations are recommended for merchantable, accessible stands.

OREGON PINE IPS
Ips oregoni (Eichh.)

Epidemic infestations of this beetle declined noticeably in 1957 from the widespread and severe outbreaks recorded in 1956. In 1957, there were only 133 centers of infestation totalling 28,640 acres, whereas in 1956 there were 324 centers and 91,940 acres of damage.

The largest acreage of damage (6,240 acres) was on the Rogue River National Forest. Numerous spot infestations developed on the Applegate District of this forest, probably from early spring logging operations in second-growth fringe stands of ponderosa pine and from trees scorched in a severe burn in 1955.

On the Wallowa-Whitman National Forests, losses in the Powder River Valley were the lowest they have been in many years. In the Starkey area, where heavy losses had occurred in 1955, no outbreaks were detected.

Only one center of damage was found in the Ukiah area on the Umatilla National Forest, where losses were widespread and severe in 1955 and 1956.

In the John Day Valley of the Malheur National Forest, only five spots of damage were detected in stands that were heavily damaged in 1956.

No direct control against this engraver beetle is warranted. Varying the time of felling and thinning operations and improving slash disposal methods should help reduce damage in reserve stands.

FIR ENGRAVER
Scolytus ventralis Lec.

Losses caused by the fir engraver in subalpine stands in 1957 were slightly less than those recorded in 1956 and considerably less than those of 1955. The area of damage during these 3 years was: 21,280 acres in 1957, 24,960 acres in 1956, and 50,520 acres in 1955.

The heaviest current mortality (5,760 acres) was found on the Umatilla National Forest. The largest concentrations of damage were again observed in the Tollgate area, particularly in the Lookingglass Creek drainage. In this area, the trees are being killed by beetles and a root rot.

Losses are building up in the Snake River area on the Wallowa-Whitman National Forests, especially in unsprayed stands that have been repeatedly defoliated by the spruce budworm.

Heaviest losses in Washington were found on the Mt. Baker and Wenatchee National Forests.

No control of these beetles is warranted at present.

SILVER FIR BEETLES
Pseudohylesinus spp.

No epidemic infestations of silver fir beetles 2/ were recorded in northwestern Washington in 1956 and it was felt that the severe epidemic, which started in 1947, had ended. However, in 1957 two light infestations totalling 1,120 acres were detected on the Mt. Baker National Forest (640 acres) and on the Snoqualmie National Forest (480 acres).

Excellent progress has been made in salvaging a large part of nearly 2 billion board-feet of timber, estimated in 1954 to be in need of salvage operations. These operations are planned for several more years because of the importance of Pacific silver fir to the economy of the Pacific Northwest.

2/ "Silver fir beetles" is a local name given to two species of *Pseudohylesinus*: *P. grandis* Sw., the grand fir bark beetle, and *P. granulatus* (Lec.), the fir root bark beetle.

Miscellaneous Forest Insects

Observations by many cooperating foresters, plus material submitted by private landowners and others to Station entomologists for identification, furnish valuable information on a variety of forest insect pests. In the Pacific Northwest, damage by some of these species has been significant in the past. Some of them may cause serious damage in the future.

A brief summary of reports on the occurrence of miscellaneous forest insects in 1957 is included as a matter of record. The reports indicated by an asterisk were verified by Station entomologists. No control measures are needed against any of these pests at this time.

Defoliators

1. *Hemlock sawfly, Neodiprion tsugae Midd.: Noticeable populations were associated with the black-headed budworm in the Snoqualmie National Forest—Mount Rainier National Park infestation area. Sawfly damage was light in comparison to that caused by the budworm.

2. Pine butterfly, Neophasia menapia (F. and F.): Adults were reported by cooperators to be very numerous in the Oregon Cascades, but no host damage was observed.

3. *Pitch nodule moth. Petrova metallica (Busck): Although this insect is not a typical defoliator, it was reported as causing damage in the form of flagging in a ponderosa pine stand in the Wenatchee, Wash., area.

4. Silver spotted tiger moth, Halisidota argentata Pack.: Large numbers of caterpillars were reported in southwestern Oregon, according to the Cooperative Economic Insect Report issued by the Plant Pest Control Division of the U. S. Agricultural Research Service.

5. *Spruce coneworm, Dioryctria reniculella (Grote): Light populations on white fir in the Lakeview, Oreg., area were reported by a cooperator.

6. *Spruce tip moth, Griselda radicana (Wlsm.): Several larvae collected by a cooperator from Douglas-fir on Ashland Mountain in Jackson County, Oreg., were identified by a Station entomologist. This is a common species on Douglas-fir but causes only minor damage to the new growth. It is commonly associated with the spruce budworm; however, in this case no spruce budworm larvae were detected.

7. Tent caterpillars, Malacosoma disstria Hbn. and M. pluviale (Dyar): These defoliators were reported by cooperators as causing serious defoliation of hardwoods in Polk County, Oreg., and in western Washington.

Bark Beetles and Bark Weevils

1. *Douglas-fir engraver, Scolytus unispinosus Lec.: Killing of Douglas-fir was reported by cooperators near Tacoma, Wash., and around the headquarters area of Olympic National Park.

2. Douglas-fir pole beetle, Pseudohylesinus nebulosus Lec.: Although this beetle is normally secondary in its attack habits, one cooperator reported damage to reproduction in the 15—20-year age class in Lane County, Oreg.

3. Douglas-fir weevil, Pissodes fasciatus Lec.: Severe killing of Douglas-fir sapling and pole stands affected by the November 1955 "deep freeze" was reported by cooperators in Clatsop County, Oreg., and in western Washington.

Aphids

1. *Spruce aphid, Aphis abietina (Wlkr.): Severe defoliation of both Engelmann and Sitka spruce was reported by several cooperators from localized areas in western Oregon.

2. *Cooley spruce gall aphid, Chermes cooleyi Gill: Although this is not generally considered to be an insect

causing severe damage, large populations were reported on Douglas-fir in the Heppner, Oreg., area and on Engelmann spruce in parts of the Gifford Pinchot and Deschutes National Forests.

3. Cinara sp.: Noticeable damage to true firs was reported on the Mt. Hood National Forest and on the Heppner District of the Umatilla National Forest.

Scales

1. Oystershell scale, Lepidosaphes ulmi (L.): Severe damage to poplar, willow and other watershed vegetation was reported in the Wenatchee, Wash., area.

2. Pine needle scale, Phenacaspis pinifoliae (Fitch): Heavy feeding was reported in city parks and other public areas in the Salem, Oreg., area.

3. Pit-making scale, Asterolecanium minus Ldgr.: Oaks in the Willamette valley were reported to be heavily attacked by this scale.

OTHER FOREST PEST PROBLEMS IN 1957

BEAR DAMAGE

Bears continued to cause severe damage to young coniferous forests throughout western Oregon and western Washington in 1957. Although tree killing was less extensive than at any time since 1953 (table 11), the depletion attributable to bears is still a serious problem to land-managing agencies.

In 1957, the damage in western Washington was noticeably less than in 1956, whereas damage in western Oregon was slightly more.

As shown in table 12, the acreage of bear damage detected in 1957 was nearly equally divided between the two States. In Oregon, heaviest losses continued to occur in the northwestern counties, particularly in Clatsop County. Heaviest losses in Washington continued to occur on the Olympic National Forest. In both States, the bulk of the damage occurs in stands already badly understocked.

Although several cooperative control projects between private forest landowners and the U. S. Fish and Wildlife Service have been successful in reducing bear populations in specific areas, a more active control program is needed.

Table 11.--Record of bear damage in western Oregon and western Washington, 1951-57

(In acres)

Year	Oregon	Washington	Total
1951	0	208,800	208,800
1952	2,560	36,160	38,720
1953	18,080	118,240	136,320
1954	97,750	194,560	292,310
1955	120,800	173,760	294,560
1956	100,140	344,000	444,140
1957	101,920	103,040	204,960

Table 12.--Extent of bear damage in 1957, by area and intensity of damage[1/]

Administrative area[2/]	Damage centers	Intensity of damage				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Oregon:						
N.W. Oregon (O.S.B.F.)	58	32,160	11,520	2,240	0	45,920
Siuslaw N.F.	32	17,920	5,280	0	0	23,200
Willamette N.F.	14	12,320	5,280	3,520	320	21,440
Mt. Hood N.F.	8	1,600	5,920	3,200	0	10,720
Umpqua N.F.	3	480	0	0	0	480
Coos Bay (O.S.B.F.)	1	160	0	0	0	160
Oregon areas	116	64,640	28,000	8,960	320	101,920
Washington:						
Olympic N.F.	39	46,720	30,720	5,760	0	83,200
G. Pinchot N.F.	15	5,600	4,160	2,240	0	12,000
S.W. Washington (W.D.N.R.)	6	1,760	1,600	0	0	3,360
Snoqualmie N.F.	5	2,400	0	0	0	2,400
Mt. Baker N.F.	3	320	1,280	0	0	1,600
Quinault I.R.	1	480	0	0	0	480
Washington areas	69	57,280	37,760	8,000	0	103,040
All areas	185	121,920	65,760	16,960	320	204,960

[1/] Areas include damage on lands of all ownerships.

[2/] N.F.: national forest; I.R.: Indian reservation; O.S.B.F.: Oregon State Board of Forestry; W.D.N.R.: Washington Department of Natural Resources.

DYING HEMLOCK

Western hemlock mortality from unknown causes has been recorded during each regional survey since 1954. Ground examinations have shown that insects are not primarily responsible. The mortality appears to be the result of a combination of factors--overmaturity, exposure from logging, an unknown pathogen, and physiological disturbances. The November 1955 "deep freeze" affected hemlocks over a wide area and must be considered as a factor in causing this mortality.

In 1957, dying hemlocks were recorded on 246,400 acres (table 13) as compared with 125,960 acres in 1956. The current damage was heaviest in southwestern Washington and on the Mt. Baker National Forest.

With this loss mostly in large-sized trees, the volume of hemlock being affected is tremendous. Salvage of dead and dying trees is the only action recommended.

Table 13.--Extent of dying western hemlock in 1957, by area and intensity of damage[1/]

Administrative area[2/]	Damage centers	Intensity of damage			All intensities
		Light	Moderate	Heavy	
	Number	----------	Acres	----------	
Washington:					
S.W. Washington (W.D.N.R.)	26	50,240	38,400	0	88,640
Mt. Baker N.F.	56	61,120	23,040	3,040	87,200
Olympic N.F.	28	16,160	17,440	0	33,600
Olympic N.P.	19	7,520	22,240	0	29,760
Snoqualmie N.F.	13	4,800	1,600	0	6,400
Makah I.R.	1	160	0	0	160
Washington areas	143	140,000	102,720	3,040	245,760
Oregon:					
N.W. Oregon (O.S.B.F.)	2	640	0	0	640
All areas	145	140,640	102,720	3,040	246,400

1/ Areas include damage on lands of all ownerships.

2/ N.F.: national forest; I.R.: Indian reservation; W.D.N.R.: Washington Department of Natural Resources; O.S.B.F.: Oregon State Board of Forestry.

PORCUPINE DAMAGE

Recording of porcupine activity during the regional aerial survey has been attempted only when large areas of damage were observed. During 1957, severe damage was detected in all fringe ponderosa pine stands along the south edges of the Ochoco and Malheur National Forests. The porcupine population in these stands must be quite high in order to cause the extensive damage detected during the survey. No estimate of the total area or intensity of this damage was attempted.

The Animal Damage Committee of the Northwest Forest Pest Action Council has an active Porcupine Work Group, which reported at the annual meeting of the Council. This group reported increased damage throughout the eastern parts of Oregon and Washington. Attention was called to a valuable publication on this pest.[3/]

APPENDIX

Organization and Conduct of Surveys

Aerial Surveys

A total of 335.2 hours of flying time (table 14) during the period June 24—September 30 and four combinations of survey personnel were required to complete the regional surveys in 1957. Practically all of the flying was completed by September 10; however, one trip on September 30 was necessary to evaluate small areas of spruce budworm infestations in the Blue Mountains of Oregon.

These surveys were again coordinated and conducted under the leadership of W. J. Buckhorn, assisted by P. W. Orr. C. B. Williams, Jr., was employed for training as an aerial observer and was indoctrinated in both aerial- and ground-survey methods.

The Oregon State Board of Forestry provided the services of Pilot A. T. Larsen and the State Cessna 170-B for 70 hours of flying time in Oregon. In order to complete the Oregon survey, the Station

---

[3/] W. H. Lawrence. Porcupine control: a problem analysis. Weyerhaeuser Timber Co. Forestry Res. Notes, 43 pp., 1957.

Table 14.--Summary of cooperative aerial-survey activities in 1957

Area covered	Timbered area surveyed	Air coverage	Survey time		
			Mapping	Ferrying	Total
	Acres	Miles	Hours		
Western Oregon	15,670,000	8,550	90.7	4.4	95.1
Eastern Oregon Cascades	6,591,000	5,110	49.2	7.5	56.7
Blue Mountains	6,964,000	4,370	43.2	5.3	48.5
Eastern Washington[1/]	7,148,000	3,450	30.6	.8	31.4
Western Washington	11,774,000	11,390	93.3	10.2	103.5
All areas	48,147,000	32,870	307.0	28.2	335.2

[1/] Except Lincoln, Pend Oreille, Spokane, Whitman, and parts of Ferry and Stevens Counties.

contracted with the State for the use of the plane and services of the pilot for an additional 64.18 hours of flying time.

The Washington Department of Natural Resources again provided the services of K. Turnbull as aerial observer during surveys in that State. He was given additional training by Buckhorn.

As in past years, Weyerhaeuser Timber Co. provided its Cessna 170-B and the services of P. G. Lauterbach and C. R. Dunbar for 70 hours of survey time. The Company's branch forests were surveyed during this time and the findings turned over to the Station for inclusion in the regional summary. Additional hours were flown to detect any large areas of windthrown timber on company holdings.

The Station used the services of two other agencies to complete the regional survey. Skyways, Inc. was low bidder on a request for the services of a Cessna 180 and pilot. A nearly new plane and Pilot R. Alexander were used for a total of 125.25 hours of survey time. The Region 6 fire control Cessna 180 and Pilot M. K. Pierce were used for 5.30 hours at the end of the season to check spruce budworm infestations.

Balsam woolly aphid infestations again received special attention in 1957. Centers of epidemic infestation were mapped in the usual manner during a special appraisal survey late in the year. In addition, a combination photographic and ground survey plan was developed and carried out for evaluating aphid damage on a special cooperative survey in the Mount St. Helens area.

A special survey was made to appraise black-headed budworm damage and to detect areas of hemlock looper activity.

Ground Surveys

Personnel of the Division of Forest Insect Research ground-checked aerial survey findings, recruised trend plots in units sprayed for spruce budworm control, conducted an egg-sampling survey to evaluate black-headed budworm populations, and provided information on endemic populations of several potentially serious pests. Also, a 3-man crew recruised the remaining 320-acre pine beetle check plots in the region, recruised spruce budworm ground plots in critical areas in western Oregon and western Washington, and conducted a special survey to locate areas of balsam woolly aphid bole infestations.

Members of the Silver Fir Beetle Committee of the Pest Action Council reexamined 330 trend plots to follow the trend of silver fir beetle damage and mortality of western hemlock from unknown causes. Other plots to determine beetle—host relations and the relation between beetles and Armellaria infections were also reexamined.

Reports of localized insect damage were received from foresters of the Bureau of Indian Affairs, Bureau of Land Management, National Park Service, and Forest Service. Foresters of private lumber companies and State agencies also submitted valuable reports of insect activity.

Table 15.--Extent of epidemic infestations in Oregon in 1957, by forest area, insect species, and intensity of infestation

Administrative area and insects involved[1/ 2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Deschutes N.F. and adjacent forest lands:						
Balsam woolly aphid	34	12,320	17,600	21,280	1,920	53,120
Mt. pine beetle (L)	33	10,400	8,800	10,400	1,280	30,880
Oregon pine ips	3	480	800	0	0	1,280
Western pine beetle	10	1,920	160	2,560	0	4,640
All insects	80	25,120	27,360	34,240	3,200	89,920
Fremont N.F. and adjacent forest lands:						
Fir engraver	5	1,120	0	0	0	1,120
Mt. pine beetle (L)	32	12,480	3,200	1,760	0	17,440
Mt. pine beetle (P)	1	0	0	160	0	160
Oregon pine ips	3	320	0	0	0	320
Western pine beetle	17	7,040	1,760	0	0	8,800
All insects	58	20,960	4,960	1,920	0	27,840

See footnotes at end of table.

Table 15.--Extent of epidemic infestations in Oregon in 1957 ... (Continued)

Administrative area and insects involved[1/ 2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Malheur N.F. and adjacent forest lands:						
Engelmann spruce beetle	1	0	320	0	0	320
Mt. pine beetle (L)	6	800	320	1,600	0	2,720
Oregon pine ips	7	640	1,760	0	0	2,400
Spruce budworm	30	203,840	132,640	31,600	0	368,080
All insects	44	205,280	135,040	33,200	0	373,520
Mt. Hood N.F. and adjacent forest lands:						
Balsam woolly aphid	77	54,400	19,520	2,400	320	76,640
Douglas-fir beetle	3	0	800	0	0	800
Mt. pine beetle (W)	9	4,160	480	0	0	4,640
Oregon pine ips	11	3,520	320	0	0	3,840
Western pine beetle	3	640	0	0	0	640
All insects	103	62,720	21,120	2,400	320	86,560

See footnotes at end of table.

Table 15.--Extent of epidemic infestations in Oregon in 1957 ... (Continued)

Administrative area and insects involved[1/ 2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Ochoco N.F. and adjacent forest lands:						
Douglas-fir beetle	3	320	320	0	0	640
Oregon pine ips	25	1,920	1,760	0	0	3,680
Spruce budworm	4	9,920	0	0	0	9,920
Western pine beetle	14	12,160	320	0	0	12,480
All insects	46	24,320	2,400	0	0	26,720
Rogue River N.F. and adjacent forest lands:						
Douglas-fir beetle	17	1,600	960	1,920	320	4,800
Fir engraver	6	1,120	0	0	0	1,120
Mt. pine beetle (L)	6	960	2,080	160	0	3,200
Mt. pine beetle (S)	1	160	0	0	0	160
Oregon pine ips	28	4,640	1,280	0	320	6,240
Western pine beetle	9	1,920	0	0	0	1,920
All insects	67	10,400	4,320	2,080	640	17,440

See footnotes at end of table.

Table 15.-- Extent of epidemic infestations in Oregon in 1957 ... (Continued)

Administrative area and insects involved[1/ 2/]	Infestation centers	Intensity of infestation: Light	Moderate	Heavy	Very heavy	All intensities
	Number	Acres				
Siskiyou N.F. and adjacent forest lands:						
Douglas-fir beetle	1	160	0	0	0	160
Oregon pine ips	3	640	0	0	0	640
All insects	4	800	0	0	0	800
Siuslaw N.F. and adjacent forest lands:						
Balsam woolly aphid	15	13,120	8,000	480	4,160	25,760
Douglas-fir beetle	6	960	0	0	0	960
Oregon pine ips	1	0	0	0	640	640
Spruce bud moth	34	22,240	11,520	0	0	33,760
All insects	56	36,320	19,520	480	4,800	61,120
Umatilla N.F. and adjacent forest lands:						
Douglas-fir beetle	1	240	0	0	0	240
Engelmann spruce beetle	1	160	0	0	0	160
Fir engraver	9	1,120	2,240	480	0	3,840
Oregon pine ips	7	960	160	0	0	1,120
Spruce budworm	5	83,840	41,600	23,200	1,120	149,760
All insects	23	86,320	44,000	23,680	1,120	155,120

See footnotes at end of table.

Table 15.--Extent of epidemic infestations in Oregon in 1957 ... (Continued)

Administrative area and insects involved[1/ 2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Umpqua N.F. and adjacent forest lands:						
Balsam woolly aphid	1	80	0	0	0	80
Douglas-fir beetle	2	320	0	0	0	320
Fir engraver	1	160	0	0	0	160
Mt. pine beetle (L)	2	320	0	0	0	320
Mt. pine beetle (W)	2	320	0	0	0	320
Oregon pine ips	4	960	0	0	0	960
All insects	12	2,160	0	0	0	2,160
Wallowa-Whitman N.F. and adjacent forest lands:						
Douglas-fir beetle	1	160	0	0	0	160
Engelmann spruce beetle	28	6,400	4,000	9,120	0	19,520
Fir engraver	9	1,120	2,400	0	0	3,520
Mt. pine beetle (L)	2	0	0	160	0	160
Mt. pine beetle (P)	1	0	480	0	0	480
Oregon pine ips	17	1,440	1,440	320	0	3,200
Spruce budworm	37	215,340	80,160	6,400	640	302,540
Western pine beetle	3	480	0	0	0	480
All insects	98	224,940	88,480	16,000	640	330,060

See footnotes at end of table.

Table 15.--Extent of epidemic infestations in Oregon in 1957 ... (Continued)

Administrative area and insects involved[1/] [2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Willamette N.F. and adjacent forest lands:						
Balsam woolly aphid	132	123,520	62,080	29,120	5,280	220,000
Douglas-fir beetle	11	1,600	640	0	0	2,240
Engelmann spruce beetle	5	4,000	480	0	0	4,480
Mt. pine beetle (W)	58	8,640	11,520	4,160	0	24,320
Oregon pine ips	2	0	320	0	0	320
All insects	208	137,760	75,040	33,280	5,280	251,360
Klamath I.R.:						
Fir engraver	1	0	160	0	0	160
Mt. pine beetle (L)	28	13,920	4,800	160	0	18,880
Oregon pine ips	1	160	0	0	0	160
Western pine beetle	7	3,520	0	0	0	3,520
All insects	37	17,600	4,960	160	0	22,720
Umatilla I.R.:						
Douglas-fir beetle	1	80	0	0	0	80
Oregon pine ips	3	0	800	0	0	800
All insects	4	80	800	0	0	880

See footnotes at end of table.

Table 15.--Extent of epidemic infestations in Oregon in 1957 ... (Continued)

Administrative area and insects involved[1/ 2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Warm Springs I.R.:						
Balsam woolly aphid	15	6,080	1,920	0	0	8,000
Mt. pine beetle (L)	1	0	0	320	0	320
Oregon pine ips	4	1,120	0	0	0	1,120
Western pine beetle	13	2,880	2,240	1,440	0	6,560
All insects	33	10,080	4,160	1,760	0	16,000
Central Oregon District (O.S.B.F.):						
Oregon pine ips	1	160	0	0	0	160
Coos Bay District (O.S.B.F.):						
Douglas-fir beetle	1	160	0	0	0	160
Northwest Oregon District (O.S.B.F.):						
Balsam woolly aphid	3	1,600	0	0	0	1,600
Douglas-fir beetle	2	160	160	0	0	320
Spruce bud moth	13	7,520	5,280	0	0	12,800
All insects	18	9,280	5,440	0	0	14,720
Lookout Mountain (B.L.M.):						
Spruce budworm	4	0	80	580	0	660

See footnotes at end of table.

Table 15.--Extent of epidemic infestations in Oregon in 1957 ... (Continued)

Administrative area and insects involved[1/] [2/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
All areas:						
Balsam woolly aphid	277	211,120	109,120	53,280	11,680	385,200
Douglas-fir beetle	49	5,760	2,880	1,920	320	10,880
Engelmann spruce beetle	35	10,560	4,800	9,120	0	24,480
Fir engraver	31	4,640	4,800	480	0	9,920
Mt. pine beetle (L)	110	38,880	19,200	14,560	1,280	73,920
Mt. pine beetle (P)	2	0	480	160	0	640
Mt. pine beetle (S)	1	160	0	0	0	160
Mt. pine beetle (W)	69	13,120	12,000	4,160	0	29,280
Oregon pine ips	120	16,960	8,640	320	960	26,880
Spruce bud moth	47	29,760	16,800	0	0	46,560
Spruce budworm	80	512,940	254,480	61,780	1,760	830,960
Western pine beetle	76	30,560	4,480	4,000	0	39,040
All insects	897	874,460	437,680	149,780	16,000	1,477,920

[1/] Admin. areas are abbreviated as follows: N.F., national forest; I.R., Indian reservation; O.S.B.F., Oregon State Board of Forestry; B.L.M., Bureau of Land Management.

[2/] Mountain pine beetle damage has been separated by tree species attacked: L, lodgepole pine; P, ponderosa pine; S, sugar pine; W, western white pine.

Table 16.--Extent of epidemic infestations in Washington in 1957, by forest area, insect species, and intensity of infestation[1/]

Administrative area and insects involved[2/ 3/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Gifford Pinchot N.F. and adjacent forest lands:						
Balsam woolly aphid	210	92,960	51,200	51,520	6,720	202,400
Black-headed budworm	6	17,760	800	0	0	18,560
Fir engraver	1	960	0	0	0	960
Mt. pine beetle (W)	89	19,040	27,520	8,640	640	55,840
All insects	306	130,720	79,520	60,160	7,360	277,760
Mt. Baker N.F. and adjacent forest lands:						
Black-headed budworm	6	22,240	1,120	0	0	23,360
Fir engraver	1	0	2,400	0	0	2,400
Mt. pine beetle (W)	40	8,000	6,240	640	0	14,880
Silver fir beetles	2	640	0	0	0	640
All insects	49	30,880	9,760	640	0	41,280

See footnotes at end of table.

Table 16.--Extent of epidemic infestations in Washington in 1957 ... (Continued)

Administrative area and insects involved[2/ 3/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Okanogan N.F. and adjacent forest lands:						
Engelmann spruce beetle	1	0	320	0	0	320
Fir engraver	2	480	800	0	0	1,280
Larch bud moth	28	16,160	16,320	4,640	0	37,120
Mt. pine beetle (L)	2	480	0	0	0	480
Mt. pine beetle (W)	1	160	0	0	0	160
Oregon pine ips	1	160	0	0	0	160
Western pine beetle	3	1,600	0	0	0	1,600
All insects	38	19,040	17,440	4,640	0	41,120
Olympic N.F. and adjacent forest lands:						
Fir engraver	1	640	0	0	0	640
Mt. pine beetle (L)	2	0	320	0	0	320
Mt. pine beetle (W)	16	3,520	960	0	0	4,480
Spruce bud moth	3	800	2,720	0	0	3,520
All insects	22	4,960	4,000	0	0	8,960

See footnotes at end of table.

Table 16.--Extent of epidemic infestations in Washington in 1957 ... (Continued)

Administrative area and insects involved[2/ 3/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Snoqualmie N.F. and adjacent forest lands:						
Balsam woolly aphid	10	3,680	320	0	0	4,000
Black-headed budworm	29	115,840	35,680	9,440	1,280	162,240
Engelmann spruce beetle	6	1,600	480	0	0	2,080
Fir engraver	2	160	480	0	0	640
Mt. pine beetle (W)	49	11,680	2,880	1,600	0	16,160
Silver fir beetles	3	480	0	0	0	480
All insects	99	133,440	39,840	11,040	1,280	185,600
Umatilla N.F. and adjacent forest lands:						
Engelmann spruce beetle	2	960	0	0	0	960
Fir engraver	3	1,920	0	0	0	1,920
All insects	5	2,880	0	0	0	2,880

See footnotes at end of table.

Table 16.--Extent of epidemic infestations in Washington in 1957 ... (Continued)

Administrative area and insects involved[2/ 3/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Wenatchee N.F. and adjacent forest lands:						
Douglas-fir beetle	3	480	0	0	0	480
Engelmann spruce beetle	1	0	480	0	0	480
Fir engraver	6	1,440	640	0	0	2,080
Larch bud moth	1	0	2,400	0	0	2,400
Mt. pine beetle (L)	9	1,600	480	0	0	2,080
Mt. pine beetle (W)	24	2,720	2,720	640	0	6,080
Oregon pine ips	2	160	480	0	0	640
All insects	46	6,400	7,200	640	0	14,240
Colville I.R.:						
Douglas-fir beetle	25	4,160	2,880	0	0	7,040
Mt. pine beetle (L)	2	160	480	160	0	800
All insects	27	4,320	3,360	160	0	7,840
Makah I.R.:						
Spruce bud moth	1	0	640	0	0	640
Quinault I.R.:						
Mt. pine beetle (W)	1	480	0	0	0	480

See footnotes at end of table.

Table 16.--Extent of epidemic infestations in Washington in 1957 ... (Continued)

Administrative area and insects involved[2/ 3/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Spokane I.R.:						
Western pine beetle	1	160	0	0	0	160
Yakima I.R.:						
Black-headed budworm	5	24,480	0	0	0	24,480
Engelmann spruce beetle	2	0	3,840	0	0	3,840
Fir engraver	2	1,280	0	0	0	1,280
Mt. pine beetle (L)	3	0	1,600	160	0	1,760
Oregon pine ips	1	0	160	0	0	160
Western pine beetle	3	960	0	0	0	960
All insects	16	26,720	5,600	160	0	32,480
Olympic N.P.:						
Fir engraver	1	160	0	0	0	160
Mt. pine beetle (W)	15	1,920	1,920	0	0	3,840
All insects	16	2,080	1,920	0	0	4,000

See footnotes at end of table.

Table 16.--Extent of epidemic infestations in Washington in 1957 ... (Continued)

Administrative area and insects involved[2/ 3/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
Mt. Rainier N.P.:						
Balsam woolly aphid	4	960	0	0	0	960
Black-headed budworm	4	16,320	0	0	0	16,320
Mt. pine beetle (W)	3	640	0	0	0	640
All insects	11	17,920	0	0	0	17,920
Glenwood District (W.D.N.R.):						
Black-headed budworm	1	6,560	1,280	0	0	7,840
Oregon pine ips	9	640	160	0	0	800
All insects	10	7,200	1,440	0	0	8,640
Southwest Washington District (W.D.N.R.):						
Balsam woolly aphid	4	7,040	0	160	0	7,200
Spruce bud moth	3	800	640	0	0	1,440
All insects	7	7,840	640	160	0	8,640

See footnotes at end of table.

Table 16.--Extent of epidemic infestations in Washington in 1957 ... (Continued)

Administrative area and insects involved[2/ 3/]	Infestation centers	Intensity of infestation				All intensities
		Light	Moderate	Heavy	Very heavy	
	Number	Acres				
All areas:						
Balsam woolly aphid	228	104,640	51,520	51,680	6,720	214,560
Black-headed budworm	51	203,200	38,880	9,440	1,280	252,800
Douglas-fir beetle	28	4,640	2,880	0	0	7,520
Engelmann spruce beetle	12	2,560	5,120	0	0	7,680
Fir engraver	19	7,040	4,320	0	0	11,360
Larch bud moth	29	16,160	18,720	4,640	0	39,520
Mt. pine beetle (L)	18	2,240	2,880	320	0	5,440
Mt. pine beetle (W)	238	48,160	42,240	11,520	640	102,560
Oregon pine ips	13	960	800	0	0	1,760
Silver fir beetles	5	1,120	0	0	0	1,120
Spruce bud moth	7	1,600	4,000	0	0	5,600
Western pine beetle	7	2,720	0	0	0	2,720
All insects	655	395,040	171,360	77,600	8,640	652,640

1/ All of Washington except Lincoln, Pend Oreille, Spokane, Whitman, and parts of Ferry and Stevens Counties.

2/ Admin. areas are abbreviated as follows: N.F.: national forest; I.R.: Indian reservation; N.P.: national park; W.D.N.R.: Washington Department of Natural Resources.

3/ Mountain pine beetle damage has been separated by tree species attacked: L, lodgepole pine; P, ponderosa pine; S, sugar pine; W, western white pine.

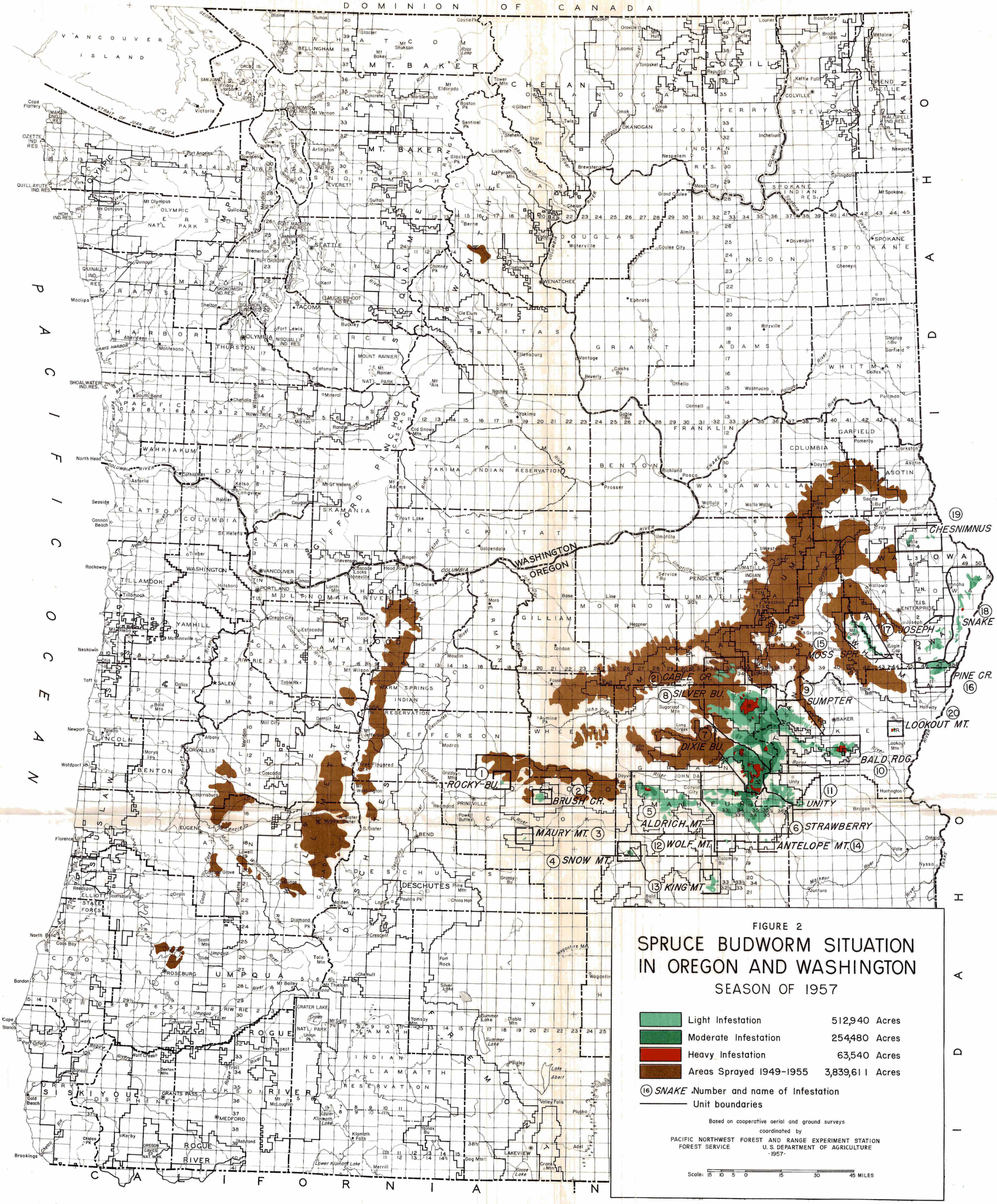


FIGURE 2

SPRUCE BUDWORM SITUATION IN OREGON AND WASHINGTON

SEASON OF 1957

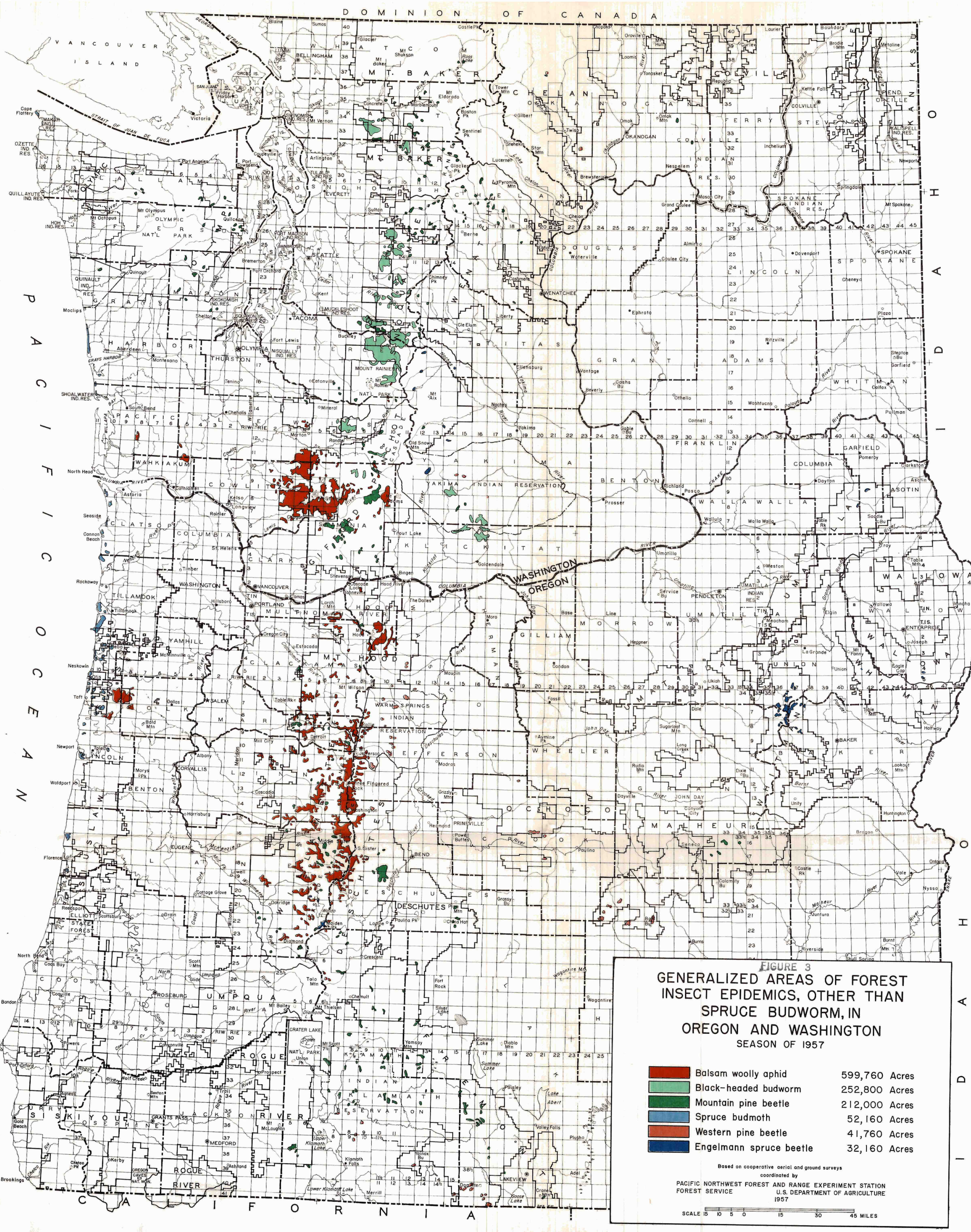
Light Infestation	512,940	Acres
Moderate Infestation	254,480	Acres
Heavy Infestation	63,540	Acres
Areas Sprayed 1949-1955	3,839,611	Acres

(16) *SNAKE* Number and name of Infestation

Unit boundaries

Based on cooperative aerial and ground surveys
coordinated by
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE U. S. DEPARTMENT OF AGRICULTURE
·1957·

Scale: 15 10 5 0 15 30 45 MILES


DOMINION OF CANADA
PACIFIC OCEAN
IDAHO
VANCOUVER ISLAND
GEORGIA STRAIT
STRAIT OF JUAN DE FUCA
WASHINGTON
OREGON
CALIFORNIA
BELLINGHAM
SEATTLE
TACOMA
OLYMPIA
VANCOUVER
PORTLAND
SALEM
EUGENE
ROSEBURG
GRANTS PASS
MEDFORD
ASHLAND
KLAMATH FALLS
LAKEVIEW
BEND
PRINEVILLE
JOHN DAY
BAKER
ENTERPRISE
PENDLETON
YAKIMA
WENATCHEE
OKANOGAN
COLVILLE
SPOKANE
LEWISTON
ASOTIN
DAVENPORT
COLFAX
PULLMAN
MOSCOW
COLUMBIA
DOUGLAS
LINCOLN
ADAMS
FRANKLIN
GRANT
BENTON
YAKIMA
KITTITAS
CHELAN
OKANOGAN
FERRY
STEVENS
PEND OREILLE
KOOTENAI
BONNER
BOUNDARY
WHITMAN
GARFIELD
ASOTIN
WALLA WALLA
UMATILLA
MORROW
GILLIAM
SHERMAN
WASCO
HOOD RIVER
KLICKITAT
SKAMANIA
CLARK
COWLITZ
WAHKIAKUM
PACIFIC
GRAYS HARBOR
THURSTON
LEWIS
CLALLAM
JEFFERSON
KITSAP
SNOHOMISH
ISLAND
SAN JUAN
WHATCOM
SKAGIT
TILLAMOOK
YAMHILL
POLK
MARION
LINCOLN
BENTON
LINN
CLACKAMAS
MULTNOMAH
WASCO
JEFFERSON
DESCHUTES
CROOK
WHEELER
GILLIAM
MORROW
UMATILLA
UNION
WALLOWA
BAKER
HARNEY
MALHEUR
LAKE
KLAMATH
JACKSON
JOSEPHINE
CURRY
COOS
DOUGLAS
LANE
FIGURE 3
GENERALIZED AREAS OF FOREST INSECT EPIDEMICS, OTHER THAN SPRUCE BUDWORM, IN OREGON AND WASHINGTON
SEASON OF 1957
Balsam woolly aphid 599,760 Acres
Black-headed budworm 252,800 Acres
Mountain pine beetle 212,000 Acres
Spruce budmoth 52,160 Acres
Western pine beetle 41,760 Acres
Engelmann spruce beetle 32,160 Acres
Based on cooperative aerial and ground surveys coordinated by
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE
1957
SCALE 15 10 5 0 15 30 45 MILES